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GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: January 13, 1978

ect Title: Issue Paper On The Organization and Integration of Flood Plain Information Into a Data Base Management System

ect No: A-2086

ect Director: Mr. Lawrie E. Jordan

nsor: Georgia Department of Natural Resources; Atlanta, Ga. 30334

eement Period: From 12/6/77 Until 6/26/78

e Agreement: Research Agreement No. 77749 dated 6/30/77 (Fixed Price)

ount: $4,500

Data
orts Required: Monthly Progress Letters; Issue Paper.

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Contractual Matters
(thru OCA)

fense Priority Rating: N/A

signed to: Electromagnetics Laboratory (School/Laboratory)

PIES TO:

Project Director
Division Chief (EES)
School/Laboratory Director
Dean/Director—EES
Accounting Office
Procurement Office
Security Coordinator (OCA) ✓
Reports Coordinator (OCA)

Library, Technical Reports Section
EES Information Office
EES Reports & Procedures
Project File (OCA)
Project Code (GTRI)
Other

—3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: 6/11/81

Project Title: Issue Paper On The Organization and Integration of Flood Plain Information Into a Data Base Management SYSTEM

Project No: A-2086

Project Director: Mr. L. E. Jordan

Sponsor: Georgia Dept. of Natural Resources

Effective Termination Date: 6/26/78

Clearance of Accounting Charges: 6/26/78 (Fixed Price)

Grant/Contract Closeout Actions Remaining:

None

- _ Final Invoice and Closing Documents
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- _ Other ______________________

Assigned to: EML/EOD (School/Laboratory)

COPIES TO:

COPIES TO:

Administrative Coordinator
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✓Reports Coordinator (OCA)
Suspense

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Library, Technical Reports
EES Research Public Relations (2)
Project File (OCA)
Other: ______________________

A-2086

MONTHLY PROGRESS LETTER NO. 1

ISSUE PAPER ON THE ORGANIZATION AND INTEGRATION OF FLOOD PLAIN INFORMATION INTO A DATA BASE MANAGEMENT SYSTEM

Research Agreement No. 77749

GT/Project No. A-2086

Prepared for

GEORGIA DEPARTMENT OF NATURAL RESOURCES
Atlanta, Georgia 30334

Prepared by

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Electromagnetics Laboratory
Atlanta, Georgia 30332

Project Director: Lawrie E. Jordan

February 9, 1978

STATUS:

Technical work has not yet begun as of this time. However, a meeting has been scheduled with the sponsor to discuss two primary issue areas as defined in the scope of services:

1. Existing and recommended forms, sources, and formats of flood plain information, and how such information is and may be applied towards the flood insurance program and flood plain management.

2. Additional sources of information which are currently available that could potentially improve delineation of the areas of interest to the flood insurance program, including advanced technologies such as satellite data and soils series information.

A schedule for completion of each of the issue areas is now being developed.

A-2086

MONTHLY PROGRESS LETTER NO. 2-5

ISSUE PAPER ON THE ORGANIZATION AND INTEGRATION OF FLOOD PLAIN INFORMATION INTO A DATA BASE MANAGEMENT SYSTEM

Research Agreement No. 77749
GT/Project No. A-2086

Prepared for

GEORGIA DEPARTMENT OF NATURAL RESOURCES
Atlanta, Georgia 30334

Prepared by

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Electromagnetics Laboratory
Atlanta, Georgia 30332

Project Director: Lawrie E. Jordan

May 22, 1978

This serves as a combined progress report for work performed through 5/10/78.

STATUS:

Regarding Issue Area 2, preliminary data displays and analyses have been performed on U. S. Army Corps of Engineers verified and estimated flood plain data in North Fulton County using the IMGRID data base management system. Mapping and correlation of this data vis-a-vis the Gannett-Flemming (Flood Insurance Program and Mapping Consultant) maps, along with comparisons of other data sources (soils series information, Landsat data), will begin as soon as the Gannett-Flemming maps can be furnished for North Fulton County.

A-2086

PROGRESS REPORT

ISSUE PAPER ON THE ORGANIZATION AND INTEGRATION OF FLOOD PLAIN INFORMATION INTO A DATA BASE MANAGEMENT SYSTEM

Research Agreement No. 77749
GT/Project No. A-2086

Prepared for

GEORGIA DEPARTMENT OF NATURAL RESOURCES
Atlanta, Georgia 30334

Prepared by

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Atlanta, Georgia 30332

Project Director: Lawrie E. Jordan

July 12, 1978

STATUS:

A meeting was held between Miles Schoenfeld, the State flood insurance coordinator and Lawrie Jordan regarding issue area 1 (existing sources of information and how it may be applied towards the flood insurance program). Additional areas of concern were also discussed:

A. There is currently no State law governing flood insurance/ flood plain management.
B. A need exists for information on where people live relative to flood hazard areas, by county or by region.
C. Data on the total development in flood plains would be desirable as well as a technique for estimating areas that are likely to attract additional development, by river basin.

The flood insurance maps requested for North Fulton County have been received. Since that time notification was given that these maps are outdated and have been revised. Copies of the new maps have been requested. Work has begun on a preliminary draft of the issue paper. However, it is not anticipated that the final camera-ready copy will be completed by June 26. Further progress requires the revised maps for North Fulton County.

A-2086

FINAL REPORT
PROJECT A–2086

AN ISSUE PAPER ON THE ORGANIZATION AND INTEGRATION OF FLOOD PLAIN INFORMATION INTO A DATA BASE MANAGEMENT SYSTEM

Submitted by

Georgia Tech Research Institute
Electromagnetics Laboratory
Electro-Optics Division
Atlanta, Georgia 30332

Submitted to

Georgia Department of Natural Resources
270 Washington Street, SW
Atlanta, Georgia 30334

Under

D.N.R. Contract No. 77749
G.T.R.I. Contract No. A–2086

MAY 1981

GEORGIA INSTITUTE OF TECHNOLOGY

Engineering Experiment Station
Atlanta, Georgia 30332

1981

AN ISSUE PAPER ON THE ORGANIZATION AND INTEGRATION OF FLOOD PLAIN INFORMATION INTO A DATA BASE MANAGEMENT SYSTEM

Submitted to
Georgia Department of Natural Resources
270 Washington Street, SW
Atlanta, Georgia 30334

Submitted by
Georgia Tech Research Institute
Electromagnetics Laboratory
Electro-Optics Division
Baker Building
Atlanta, Georgia 30332

D.N.R. Contract Number - 77749
G.T.R.I. Contract Number - A-2086

May 18, 1981

SECURITY CLASSIFICATION OF THIS PAGE (*When Data Entered*)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER A-2086	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
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7. AUTHOR(*s*) N. L. Faust		8. CONTRACT OR GRANT NUMBER(*s*) A-2086
9. PERFORMING ORGANIZATION NAME AND ADDRESS Georgia Tech Research Institute Electromagnetics Laboratory Electro-Optics Division		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Georgia Department of Natural Resources 270 Washington Street, SW Atlanta, GA 30334		12. REPORT DATE 13. NUMBER OF PAGES 32
14. MONITORING AGENCY NAME & ADDRESS(*if different from Controlling Office*)		15. SECURITY CLASS. (*of this report*) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (*of this Report*)

17. DISTRIBUTION STATEMENT (*of the abstract entered in Block 20, if different from Report*)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (*Continue on reverse side if necessary and identify by block number*)

Geographic Data Base
Flood Plain Planning

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

Application of geographic data base techniques to flood plain management is discussed with an example data base.

Table of Contents

INTRODUCTION

Map information for flood plain management can come in many forms. These varied forms and scales can be both a benefit and also create confusion for the user community. Confusion can result when the user is not familiar with the philosophy behind the map production and is therefore unfamiliar with issues such or resolution and minimum mapping unit.

The U.S. Geologic Survey (U.S.G.S.) produces topographic quadrangle maps at 1:24,000, 1:100,000 and 1:250,000 scale. In Georgia, the Department of Transportation (DOT) produces county base maps at a scale of 1:63,360 or 1" = 1 mile. The Georgia DOT maps are especially useful since each county is updated every five years based upon recent aerial photography produced by DOT.

Recent studies have cited the need for flood plain information to delineate natural and man-made features. In order to be useful, the maps should show areas of population, elevations above mean sea level, numbers of people living in an area, location of hospitals and civil defense areas, transportation routes and bridges and areas of new road construction. Also, the maps must be current and detailed. As an example, the U.S.G.S. maps at 1:24,000 can be quite useful, provided the information is presented in its most recent form.

The FIA flood hazard boundary maps and flood insurance rate maps at 1:24,000 are at present the only nationwide effort at mapping flood areas. In addition to these efforts, the NOAA/NOS has produced the storm evacuation series at 1:62,500. These maps show contours, elevations of the land, flood stages, evacuation routes, transportation systems and other population related information within most coastal areas.

In addition to the above map sources, several other types of information are available for flood plain management efforts. This information includes S.C.S. soil surveys, U.S. Army Corps of Engineer's flood plain information studies, U.S.G.S. orthophoto quadrangles, local land use and topographic maps and available aerial photography.

This report will attempt to describe how an automated mapping system can assist in the merging of various types and scales of flood plain information. To perform this task, several sources and formats of flood plain information will be evaluated, several new technologies for mapping flood plain information will be discussed, methods for integrating the information will be discussed, and scenarios for future applications will be described.

THE STUDY AREA

From preliminary meetings with staff from the Environmental Protection Division of the Department of Natural Resources, a demonstration study area was selected. The area selected meets several criteria that makes it attractive as a pilot or demonstration area. The study area needed to contain two complete Water Quality Management Units in order to compare non-point emission characteristics between two WQMU's. To run program tests for solid waste management, the area had to contain a functionally complete political boundary. The number of data cells in the study area that could be displayed on the Georgia Tech color graphics display limited the study area to approximately 300 square miles. In addition to these criteria, an area having a mix of characteristics (urban and rural) tested the utility of a 7 1/2" (10.72 acre) grid cell size. Urban areas may require a smaller grid cell, while larger grid cells may suffice in rural areas.

According to these criteria, North Fulton County appeared to be an area where the maximum number of tests can be accomplished and still be within current test capacity limits. Figure 1 demonstrates how the computer mapping and analysis system can be used to delineate areas of development within a flood plain.

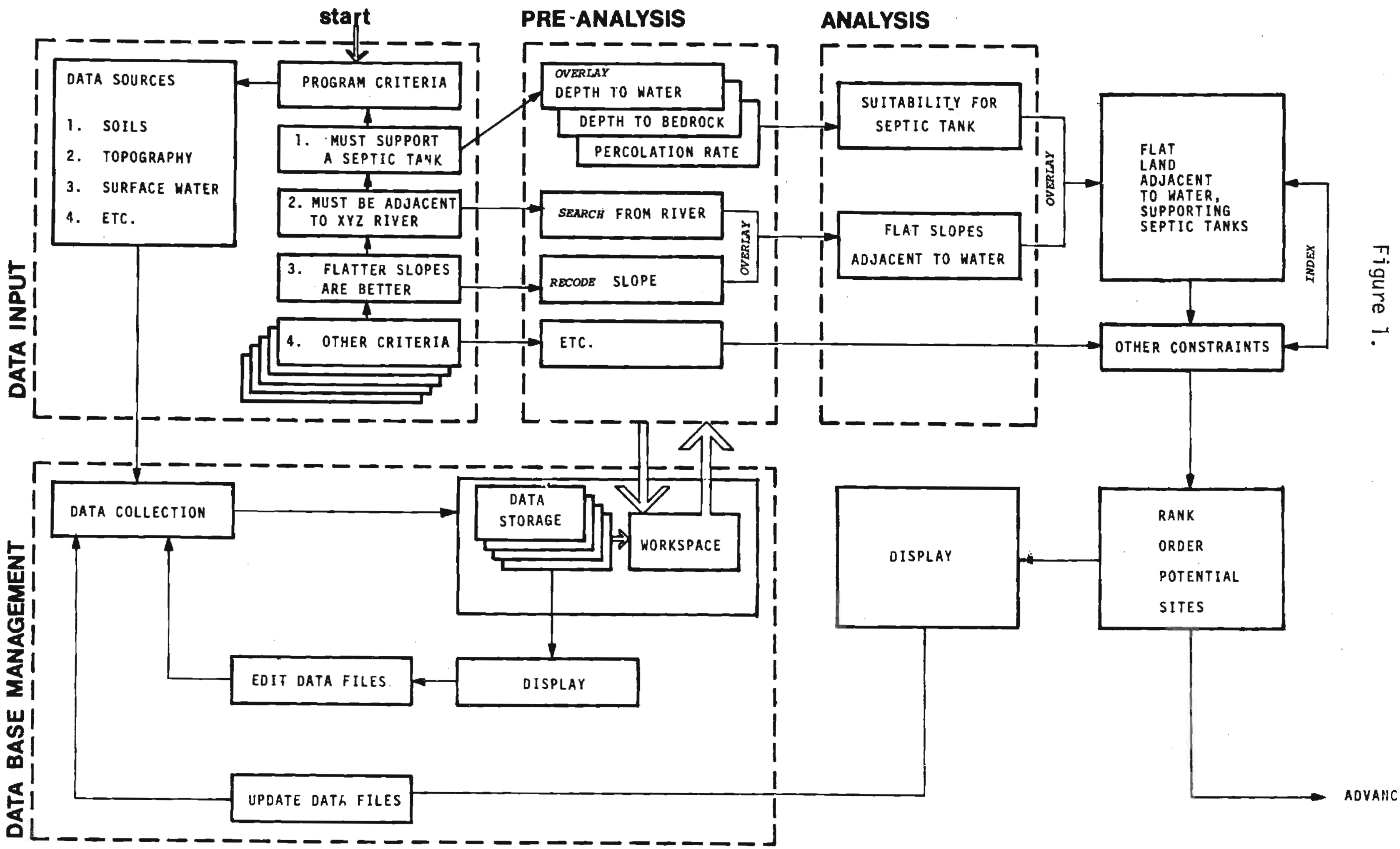

start
PRE-ANALYSIS
ANALYSIS
DATA INPUT
DATA SOURCES
1. SOILS
2. TOPOGRAPHY
3. SURFACE WATER
4. ETC.
PROGRAM CRITERIA
1. MUST SUPPORT A SEPTIC TANK
2. MUST BE ADJACENT TO XYZ RIVER
3. FLATTER SLOPES ARE BETTER
4. OTHER CRITERIA
OVERLAY
DEPTH TO WATER
DEPTH TO BEDROCK
PERCOLATION RATE
SEARCH FROM RIVER
RECODE SLOPE
OVERLAY
ETC.
SUITABILITY FOR SEPTIC TANK
FLAT SLOPES ADJACENT TO WATER
OVERLAY
FLAT LAND ADJACENT TO WATER, SUPPORTING SEPTIC TANKS
INDEX
OTHER CONSTRAINTS
DATA BASE MANAGEMENT
DATA COLLECTION
DATA STORAGE
WORKSPACE
EDIT DATA FILES
DISPLAY
UPDATE DATA FILES
DISPLAY
RANK ORDER POTENTIAL SITES
ADVANCE

Figure 1.

SECTION 1 - DESCRIPTION OF THE NORTH FULTON STUDY AREA

The North Fulton County study area lies wholly within the Atlanta Plateau, which is a part of the Piedmont province. The Piedmont is a major physiographic province of the eastern United States and extends from southern New York State to Alabama. The Atlanta Plateau has a rolling surface characterized by moderate slopes. The most striking feature of the study area is the Chattahoochee River valley which varies from 150 to 400 feet in depth and from 2 to 5 miles in width.

The surface features of the study area are characterized by rolling to hilly slopes with smooth uplands. The largest areas of smooth land in the study area are near Roswell and Alpharetta. The study area is most dissected along the Chattahoochee and some of the larger tributaries. These areas have steep V-shaped valleys and sharp ridgetops, and their slopes range from 20 to 40 percent. The rolling land has lowland and upland areas with deposits of colluvial-alluvial material which can be found in depressions and along the drainageways.

Level to nearly level flood plains occur along the Chattahoochee River and its tributaries. These flood plains range from a few yards to approximately half a mile wide in the northern portion of the county. Remnants of stream terraces are visible above the flood plain at a minimum of two levels. In general, the alluvial deposits making up these terraces are thin and dissected by drainageways.

The elevation above sea level where the Chattahoochee River enters the county is approximately 900 feet. The highest elevations in the study area range from 1,100 to more than 1,200 feet in elevation.

The drainage system of the county is characterized by a dendritic pattern. This pattern is well developed throughout the upland areas and surface drainage is good. The bottomlands of the Chattahoochee River and its tributaries are well drained but subject to overflow conditions during the year. In many places along the streams, sediments which have recently worked from the surrounding uplands have filled the channels and altered drainage patterns. The alteration of drainage patterns has resulted in additional flooding potential and loss of property.

The maps on the following page (Figures 2 and 3) show the demonstration project study area. This portion of North Fulton County Study Area (including portions of East Cobb, Northern Dekalb and Western Cobb counties) was chosen because it meets several criteria that make it attractive as a pilot or demonstration site. The study area contains two complete Water Quality Management Units which allow for comparison of the non-point source characteristics between the two WQMU's. The area is also of reasonable size so as not to exceed the storage capacity limitations currently assigned to the computer. In addition, the area has a mix of urban and rural characteristics which should adequately test the utility of the 7.5 second (10.72 acre) grid cell size.

Figure 2.

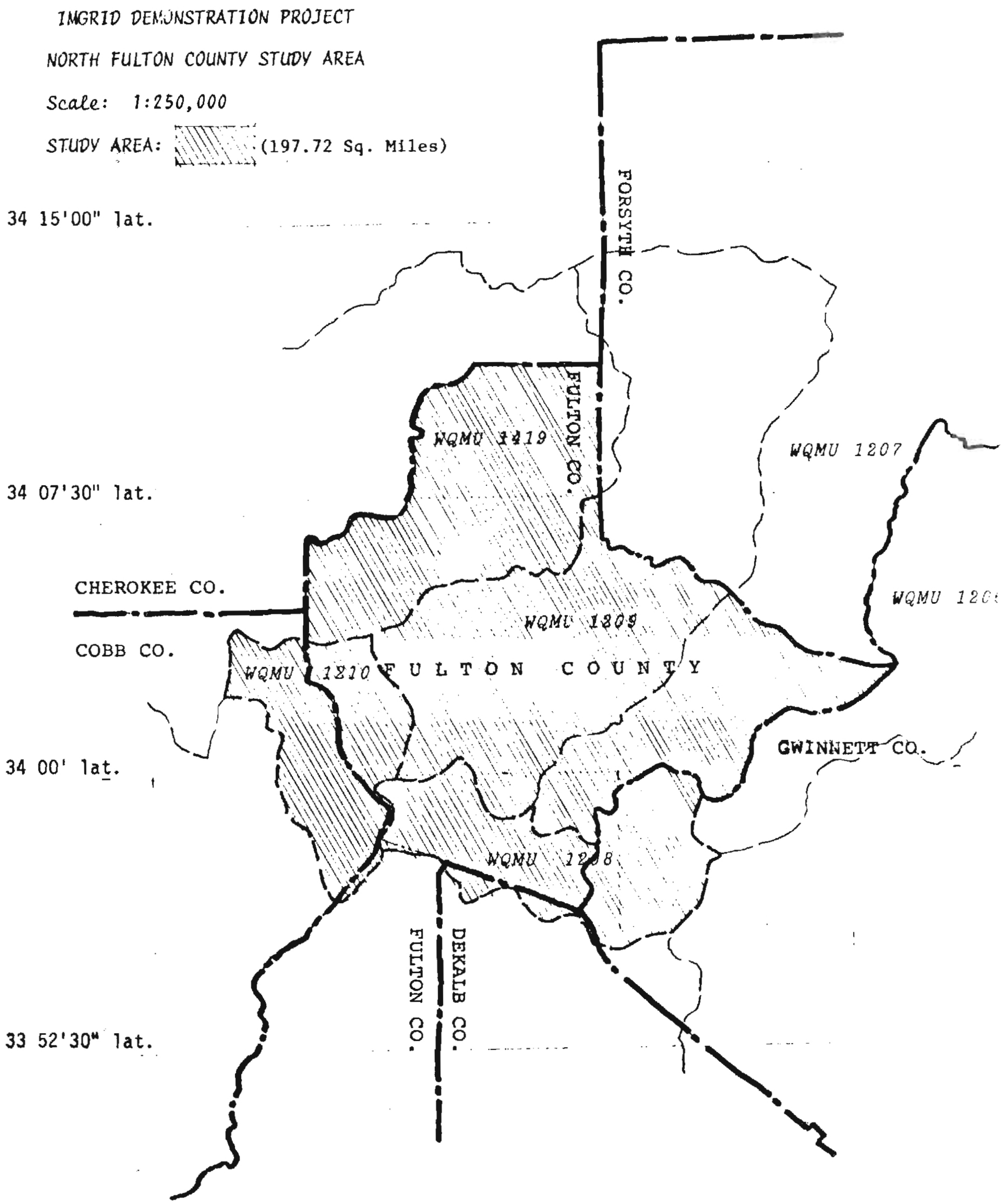

IMGRID DEMONSTRATION PROJECT
NORTH FULTON COUNTY STUDY AREA
Scale: 1:250,000
STUDY AREA: (197.72 Sq. Miles)
34 15'00" lat.
34 07'30" lat.
34 00' lat.
33 52'30" lat.
FORSYTH CO.
FULTON CO.
WQMU 1419
WQMU 1207
CHEROKEE CO.
COBB CO.
WQMU 1209
WQMU 1210
FULTON COUNTY
GWINNETT CO.
WQMU 1208
FULTON CO.
DEKALB CO.

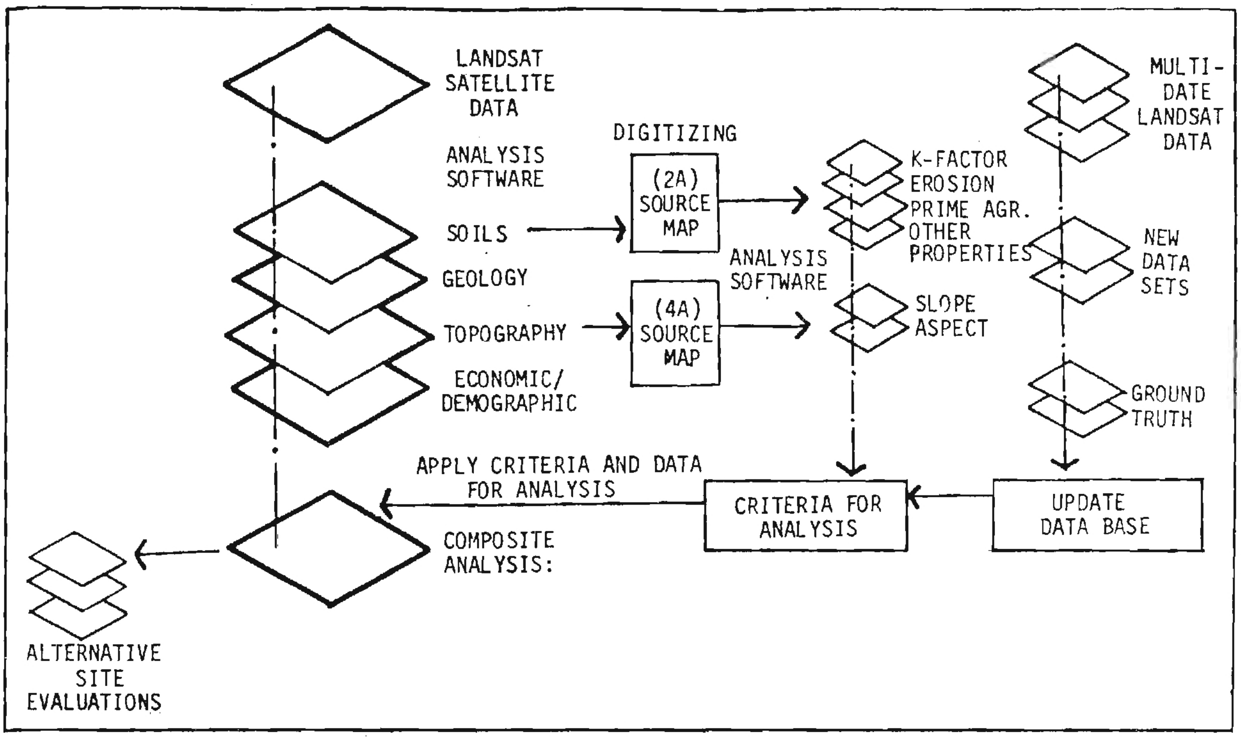
Figure 3.

SECTION 2 - DISCUSSION OF DATA BASE APPROACH

For years the Department of Natural Resources has expressed the need for an efficient means of collecting, storing, retrieving, and processing natural resource data for a wide variety of uses. The Georgia Tech Research Institute has worked specifically toward the development of such a data system. In cooperation with the National Aeronautics and Space Administration, Georgia Tech developed, on a test basis, land cover characteristics from Landsat derived data. While this effort did not yield data on a statewide basis, it did produce data on a regional basis that was sufficiently useful to a variety of State, Federal, and local agencies to initiate the statewide effort which followed in 1978.

Land cover data generated from the statewide Landsat project was used by the Water Protection Branch of EPD in the assessment of current run-off characteristics for each of the state's 198 Water Quality Management Units. Other agencies at both the Federal and Local levels participated in the statewide effort and used the data in a variety of applications.

Land cover data alone, however, has only limited application to the wider range of resource management programs within DNR. In order to achieve maximum utilization of Landsat derived data, it is necessary to combine it with other data, such as soils, land use, topography, and geology collected from a variey of sources. In order to do this in an effective and efficient way, the data must be compatible at equivalent scales and must be stored in a format that allows for easy access and flexible maniputlation (Figure 4). Given these requirements, it is reasonable to explore the use of computer assisted technology for these purposes.



The flow of information through the analysis process is represented in the diagram above. Landsat Satellite Data is in digital form and contains 1/4 - 1.1 acre detail about land cover conditions. Using analysis software the Landsat data set is geometrically corrected and fitted to a standard coordinate system such as latitude-longitude or UTM coordinates. The data set is then processed using a maximum-likelihood or unsupervised clustering algorithm to provide specific land cover categories in scale mapped form. A major benefit to the decision-maker using Landsat is its 18-day repetitive coverage for multi-date analysis and change detection. Other geographic data are then merged with the Landsat data in the established coordinate system. Soils series data are integrated in a very efficient manner by first digitizing the source map and then using analysis software automatically producing associated maps without requiring any new digitizing. Other variables such as topography can be used in a similar fashion to automatically create slope and aspect maps. These automated techniques represent a significant decrease in the time and work involved in creating and merging information into the data base framework.

Criteria are then formulated and applied to the data using an interactive analysis methodology with full capabilities for vertical integration (e.g. overlay, matrix, index, etc.). As well as horizontal proximity analysis (search) and statistical routines. The composite analysis is then quickly produced, evaluated, and where appropriate, compared against alternative scenarios and reused as new data from Landsat and other sources are integrated.

Figure 4

Until recently, manipulation of natural resource data by a computer has had fairly limited application for most resource management programs. Part of this problem has been in the geogrpahic or "spatial" nature of most of these programs, and part of the problem has been the requirement for specialized training in computer languages in order to use the machines. In the past few years, however, improvements have been made in these areas, allowing for both mapped (geographic) computer output, and for direct access to the machine by program managers who have not had extensive training in computer programming. These improvements are generally in the form of a "packaged" set of computer mapping programs that can be used on one or more types of computers, and operate through a simplified set of programming commands.

This project will test the potential use of automated computer mapping for the organization and integration of flood plain information. In addition to the use of the North Fulton County Data Base for non-point source pollution and alternative siting for solid waste management, the potential arose to implement the system for floodplain management studies. Data management tests were undertaken in an attempt to merge Landsat derived data and S.C.S. soil data with other natural and land use information.

LANDSAT DATA FILE MERGER

Landsat derived data has been generated and classified in a cooperative project among 14 State, Federal, and Local public agencies operating in Georgia. This data has been geographically referenced to latitude-longitude coordinates at a maximum resolution unit of 1.1 acres. This data, while sufficiently useful to the 14 cooperating agencies to warrant current expenditures, could be made even more useful by merging it with additional natural and cultural resource data. By performing this test Georgia Tech personnel will demonstrate an increase in the utility of the Landsat information by geographically referencing it to other natural resource and cultural data. At present, Landsat information represents one data element which can be used more successfully for analysis when integrated with other natural resource data. What is being proposed is a merging of Landsat data into a computerized filing and mapping structure which will enable data to be manipulated according to ones program criteria.

S.C.S. SOILS DATA MERGER

Soils data will be subdivided into characteristics files (for example: permeability, ph., K and T factors, depth to waterable, and depth to bedrock), and merged with other natural and cultural resource data in a common mapping system. The SCS State Soil Scientist has cooperated extensively with DNR in completing this test. Each soil series mapping unit within the study area was coded and entered into a master reference file. The associated characteristics of each soil type were then recorded in separate characteristics files (see Technical Appendix #1). Each soil characteristic was then given a common latitude-longitude coordinate for reference, and mapped either separately or re-combined with other data for analysis purposes. For example, depth to seasonal high water table can be mapped separately, or combined with permeability rate for use in screening potential sites for sanitary landfills.

THE DATA SET

The data categories and items were selected jointly by the Environmental Protection Divison and Georgia Tech staff. The data listing is felt to be sufficiently complete to run the flood plain management program tests. This is not a complete data set. It is fully expected that additional data inputs could be made, as additional program tests and evaluations might require. The data inputs are flexible, and can be changed simply by a computer-assisted editing procedure. The following is a list of the data categories, elements and items.

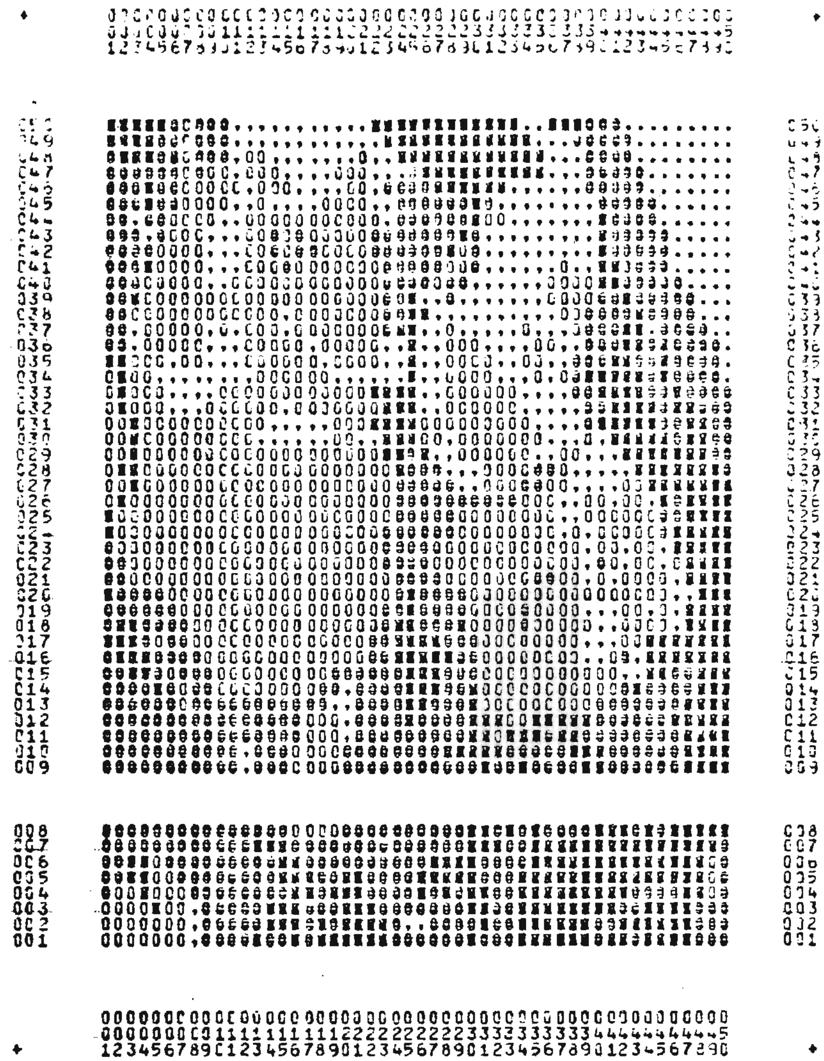
THE DATA BASE

Data elements and items were collected from existing data sources and coded for entry into the computer data base. A gridded data base referenced the information to grid cells at 7 1/2" (second) intervals, referenced to the four corner coordinates of each USGS quadrange map within the study area. The area contained within each grid cell is 10.72 acres at $34^{o}00'$ latitude. (The acreage within a 7 1/2" grid cell would vary with latitude). Each item within a data element will receive a code and will be stored as a discreet piece of information.

The data was recorded (coded) either as "presence within a cell" or as "majority within a cell" depending upon the nature of the element being recorded. Area data such as soils, and vegetation will be recorded as majority: point or line information such as highways, streams, historic sites, etc will be recorded if present within a cell.

Each data item can be mapped separately by the computer or combined with other data. Figure 5 is an example of a mapped data element (permeability rate) showing each item within the element. (This map was made from an existing base that is currently in use at Georgia Tech for "de-bugging" computer programs. It is shown here as an example only.)

PERMEABILITY RATE (LAYER 3, SEPTIC LAYER)



1

THIS IS SUB SET OF A DATA BASE CREATED BY STUDENTS IN THE OMNIBUS STUDIO
FALL 1968 IT IS USED FOR DEMONSTRATION PURPOSES

LEVELS	0	1	2	3	4	5	6	7	8	9
FREQUENCY	89	321	0	0	0	854	0	738	0	498
	100% Water	Very Slow	Null	Slow	Null	Mod. Rapid	Null	Rapid	Null	No Input

Figure 5.

SECTION 3 - TECHNIQUES FOR ANALYSIS

After the initial data collection and editing have been performed as described in the previous section, the data base is now ready for use as a management and information tool as part of the analysis phase.

There are three general types of analyses that can be performed using a data base constructed in this manner (see Figures 6-7):

1. Overlay of multiple variables.
2. Scaling or weighting of variables as part of an attractiveness or vulnerability analysis.
3. Proximity analysis, or horizontal searching.

An example of the first type (an overlay of multiple variables) follows in a step-by-step manner:

ISSUE: Where within the study area does development exist within either a verified or estimated flood plain and what types of development are included:

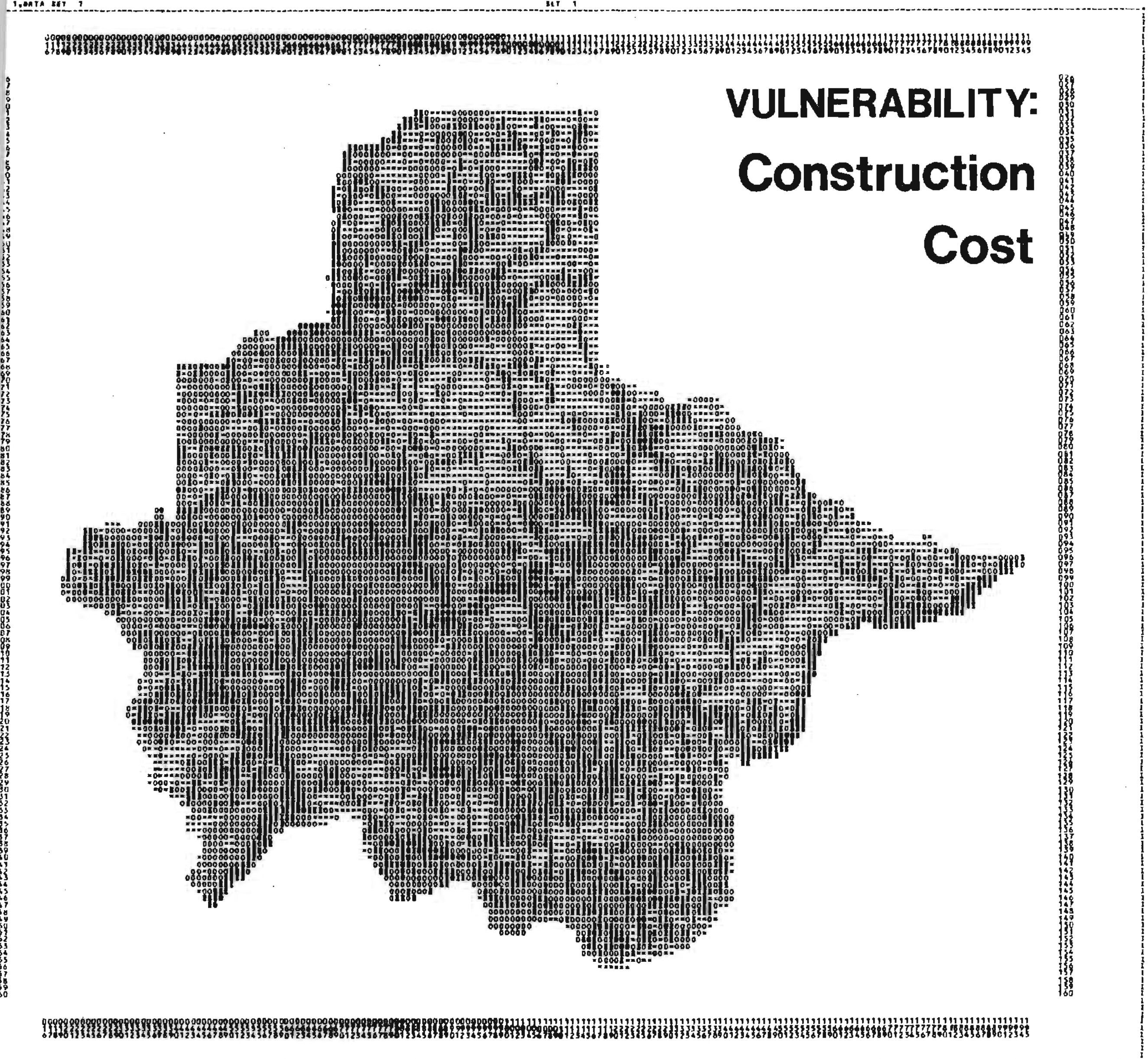
TECHNIQUE FOR ANALYSIS:

(1) The appropriate data variables are requested from the Data Base:

A. Variables #13 = wetlands - floodplains

B. Variable #10 = land cover (Landsat) (note - further detail could be obtained by submitting variables #1-9 for more specific land use breakdowns)

(2) Rescale the data values for each sub-category within the 2 variables so that the desired categories have high values and therefore override other categories:



RELATIVE COST OF CONSTRUCTION
VARIABLES USED:
#16 TOPOGRAPHIC SLOPE
#13 FLOODPLAIN
#31 DEPTH TO BEDROCK
#16 GEOLOGY - QUARTZITE RIDGES
#20 SOILS OF CONCERN
#30 DEPTH TO WATER TABLE
#34 CORROSIVITY

CONTINUOUS GRAY SCALE GRADES FROM :

LIGHT GRAY = LOWER COST FOR CONSTRUCTION
TO
DARK GRAY = HIGHEST COST OF CONSTRUCTION

DATA MAPPED IN 5 LEVELS BETWEEN EXTREME VALUES OF .00 AND 39.00 MEAN = 12.87 ST. DEV. = 6.54

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	.00	7.80	15.60	23.40	31.20
MAXIMUM	7.80	15.60	23.40	31.10	39.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

20.00	20.00	20.00	20.00	20.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVELS	0	1	2	3	4
SYMBOLS					
FREQUENCY	2454	5149	3004	615	29

A C R E A G E   D I S T R I B U T I O N   S U M M A R Y

LEVELS	0	1	2	3	4	5
ACREAGE	26306.9	55197.3	32202.9	6592.8	310.9	.0

LEVELS	6
ACREAGE	.0

CELL SIZE = 10.72

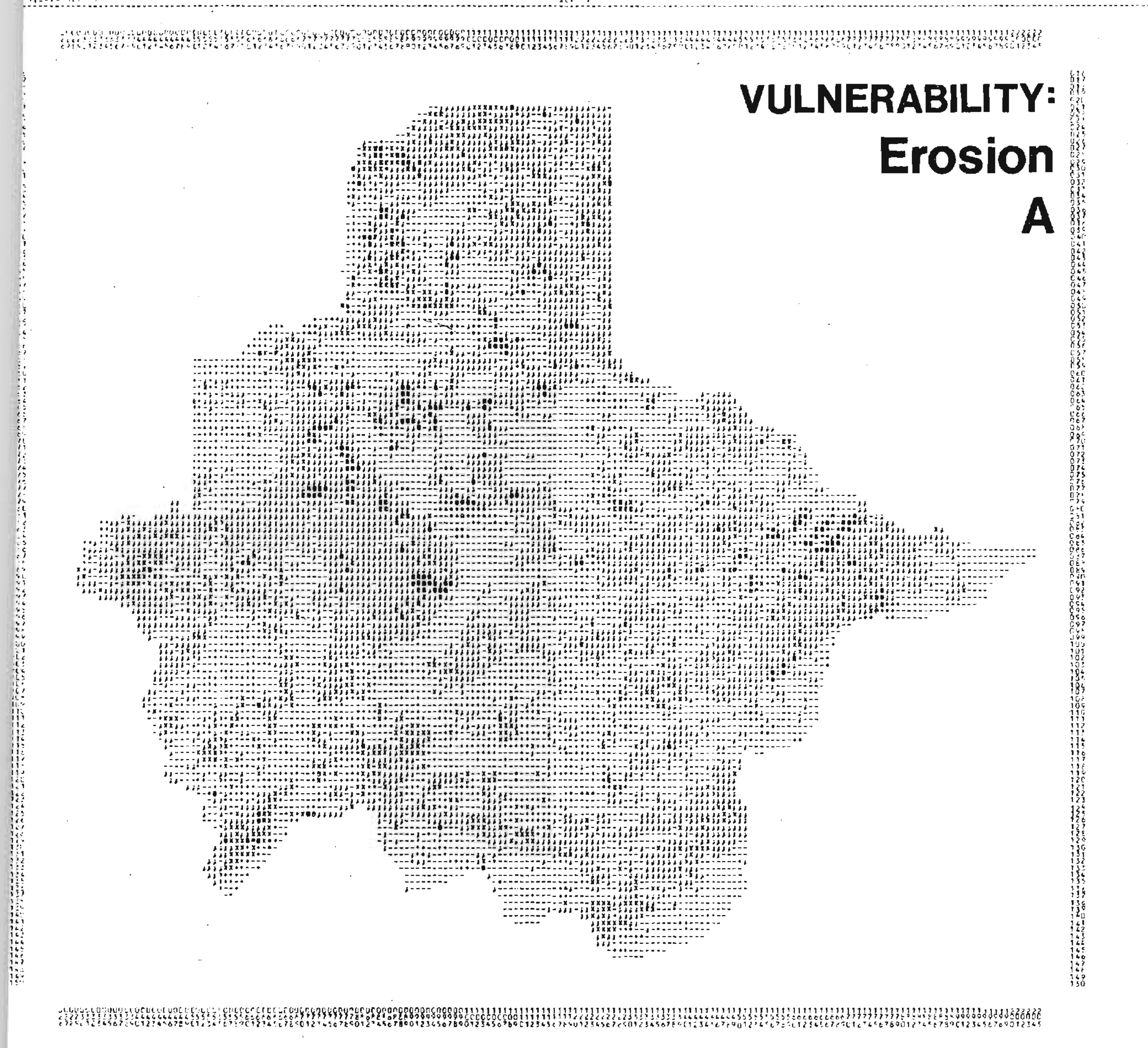
SUMMARIZE LINEAR COMBINATION

VARIABLE 16 WT. 1.00 VALUES	0	1	2	3	4	5	6	7	8
RECODE	0	0	0	0	9	9	9	0	0
VARIABLE 30 WT. 1.00 VALUES	0	1	2	3	4	5	6	7	5
RECODE	9	9	9	8	7	4	1	1	0
VARIABLE 31 WT. 1.00 VALUES	0	1	2	3	4	5	6	7	8
RECODE	0	9	9	7	5	3	1	1	0
VARIABLE 14 WT. 1.00 VALUES	0	1	2	3	4	5			
RECODE	0	0	0	4	7	9			
VARIABLE 13 WT. 1.00 VALUES	0	1	2	3					
RECODE	0	5	5	5					
VARIABLE 20 WT. 1.00 VALUES	0	1	2	3	4	5			
RECODE	0	6	5	5	9	5			
VARIABLE 34 WT. 1.00 VALUES	0	1	2	3					
RECODE	0	5	5	8					

13 GRID NUMBERING BEGINS AT R= 26 C= 16

18 ACREAGE SUMMARY OPTION
CELL SIZE = 10.7 OUTPUT UNIT= 6

Figure 6.



0 = LITTLE OR NO EROSION
1 = STEEP SLOPE [illegible]
2 = EXCESSIVE K [illegible] TONS/ACRE/YR)
3 = 1+2 STEEP SLOPE AND EXCESSIVE K
4 = UNPROTECTED SOIL (BARE OR CULTIVATED)
5 = 1+4 STEEP SLOPE AND UNPROTECTED SOIL
6 = 2+4 EXCESSIVE K AND UNPROTECTED SOIL
7 = 1+2 3 WORST EROSION CONDITION

DATA MAPPED IN 10 LEVELS BETWEEN EXTREME VALUES OF .50 AND 10.50 MEAN = [illegible] ST. DEV. = [illegible]

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50
MAXIMUM	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVELS	LOW VALUES	1	2	3	4	5	6	7	8	9	10	HIGH VALUES
SYMBOLS												
FREQUENCY	[illegible]	1472	4616	[illegible]	[illegible]	[illegible]	334	16	0	0	0	4107

ACREAGE DISTRIBUTION SUMMARY

LEVELS	0	1	2	3	4	5
ACREAGE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LEVELS	6	7	8	9	10	11
ACREAGE	[illegible]	171.5	[illegible]	[illegible]	[illegible]	[illegible]

CELL SIZE = [illegible]

Figure 7

Variable # 13 - Wetlands

DATA VALUES	NEW VALUE
1 = NONE	4
2 = MARSH	4
3 = ESTIMATED FLOODPLAIN	1
4 = VERIFIED FLOODPLAIN	1

Variable #10 - Land Cover

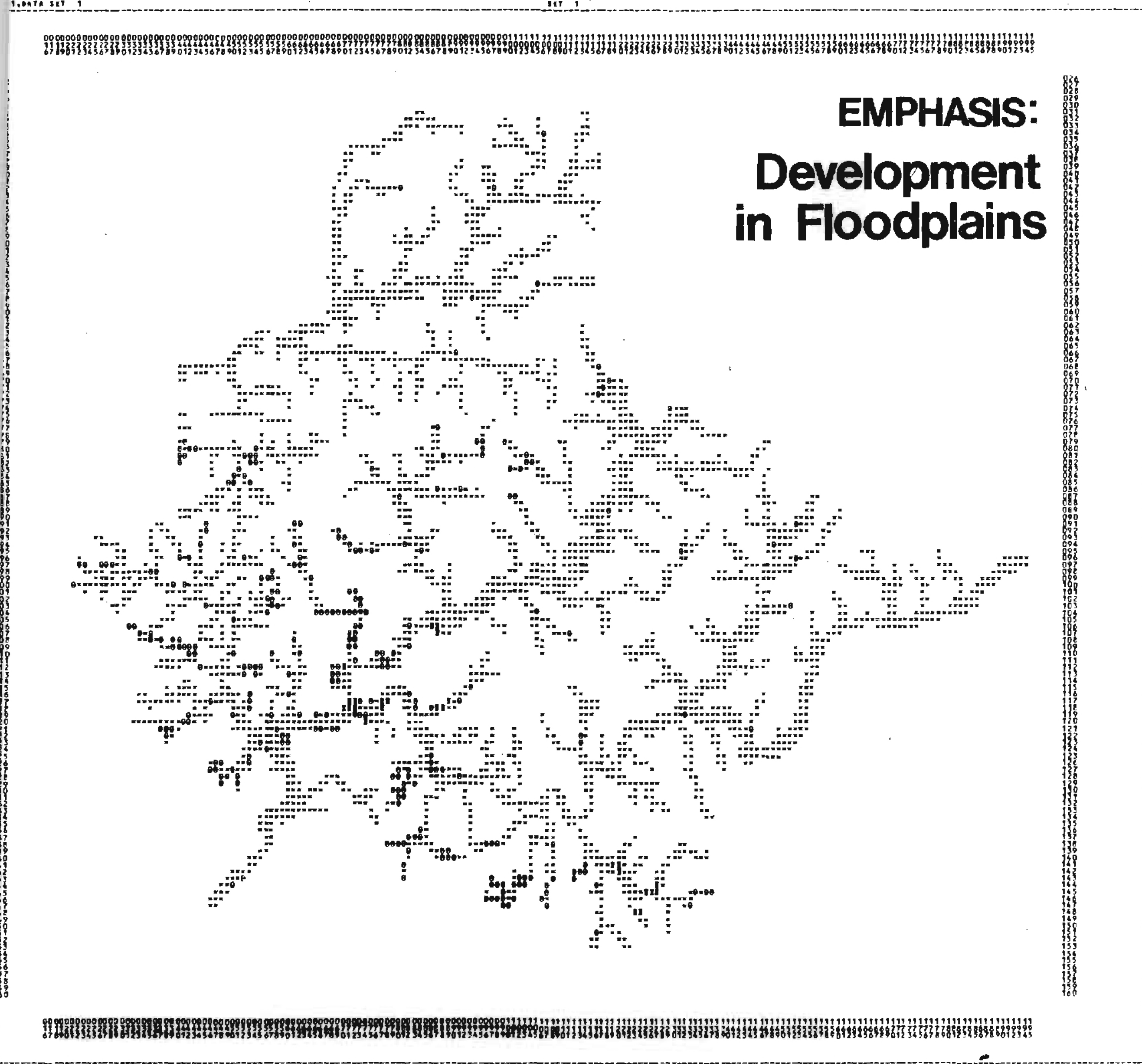
DATA VALUES	NEW VALUE
1-7 = Non-development	0
8 = Low density development	2
9 = High density development	3

(3) Instruct the data base system to map the above criteria with a different gray-scale symbol representing each of the new categories;

0 = not applicable (undeveloped, not in floodplain)
1 = floodplains, undeveloped
2 = low density development within floodplains
3 = high density within floodplains
4 = mask out non-flood prone areas

A more detailed map using this same analysis technique is shown in Figure #8, Titled "EMPHASIS: Development in Floodplains". Also, alternative display techniques can be used, such as color computer graphics, to illustrate the same analysis in a clearer way as shown in Figure #9.

EMPHASIS: Development in Floodplains



LAND USE OCCURRING WITHIN THE FLOOD PLAIN

1 = UNDEVELOPED FLOOD PLAIN
3 = INSTITUTIONAL
4 = SINGLE FAMILY RESIDENTIAL
5 = MULTI-FAMILY RESIDENTIAL
6 = COMMERCIAL
7 = OFFICE OR INDUSTRIAL PARK
8 = MANUFACTURING

DATA MAPPED IN 10 LEVELS BETWEEN EXTREME VALUES OF .50 AND 10.50 MEAN = 1.29 ST. DEV. = .93

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50
MAXIMUM	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50	10.50

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVELS	0 (LOW VALUES)	1	2	3	4	5	6	7	8	9	10	11 (HIGH VALUES)
FREQUENCY	1	3203	0	3	225	25	3	1	4	1	0	0

A C R E A G E   D I S T R I B U T I O N   S U M M A R Y

LEVELS	0	1	2	3	4	5
ACREAGE	10.7	34336.2	.0	32.2	3055.2	268.0
LEVELS	6	7	8	9	10	11
ACREAGE	32.2	10.7	42.9	10.7	.0	.0

CELL SIZE = 10.72

SUMMARIZE LINEAR COMBINATION

VARIABLE 3 WT. 1.00 VALUES	0	1	2	3	4	5	6			
RECODE	0	0	0	3	3	3	3			
VARIABLE 4 WT. 1.00 VALUES	0	1	2	3	4	5				
RECODE	5	4	4	4	4	4				
VARIABLE 5 WT. 1.00 VALUES	0	1	2	3	4					
RECODE	0	5	5	5	5					
VARIABLE 6 WT. 1.00 VALUES	0	1	2	3	4	5	6	7		
RECODE	0	6	6	7	7	0	0	0		
VARIABLE 8 WT. 1.00 VALUES	0	1	2	3	4	5	6	7	8	
RECODE	0	2	2	2	2	2	0	2	2	
VARIABLE 13 WT. 1.00 VALUES	0	1	2	3						
RECODE	-99	1	1	1						

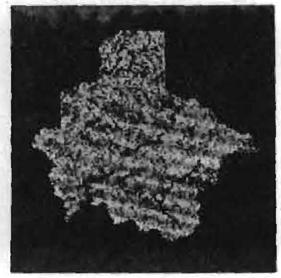
13 GRID NUMBERING BEGINS AT R= 26 C= 16

17 ACREAGE SUMMARY OPTION
CELL SIZE = 10.7 OUTPUT UNIT= 6

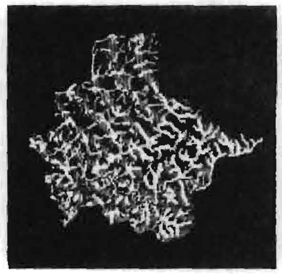
Figure 8


10. Floodplains

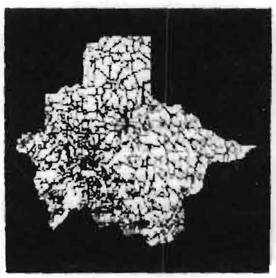

11. Elevation

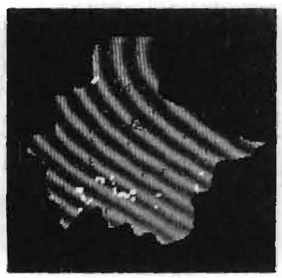

12. Slope


13. K-factor

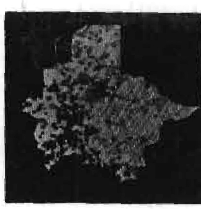

14. Surface water type

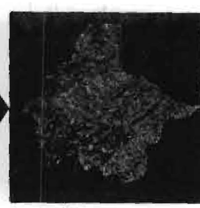

15. Geology

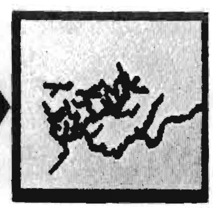

16. Transportation


17. Historic sites


18. Land cover


19.


20.


21.

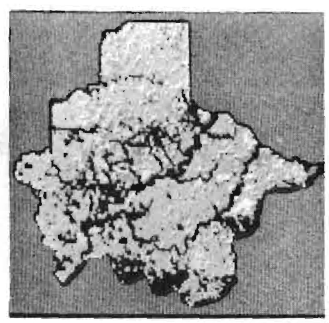

22.

Figure 9

By using various combinations of the three analysis techniques (overlay, weighting, proximity analysis) it may be possible to create an accurate equivalent to existing mapped floodprone areas. The most likely variables to be included in such an analysis would be alluvial soils, topographic elevation, and vegetation land cover. The level of detail or resolution, of the data base needs to be carefully studied prior to such an effort to ensure that the grid size (or polygon size) is fine enough to capture the relevant data. The limiting factor in developing this methodology would be cost of creating the data base in a manual way. However, the opportunity now exists to acquire most of this information already in digital form:

Soils - U.S.D.A., Soil Conversation Service
M.I.A.D.S. tapes

Topography - U.S.G.S. digital terrain tapes (NCIC)

Vegetation - Landsat tapes (1/4 - 1.1 acre)

Such being the case, automated techniques could then be employed to rapidly evaluate any area for flood prone conditions, and determine if any further field work or ground truth needs to be acquired. This could result in a significant savings in time and resources, and make more efficient use of personnel involved.

Beyond this, there are perhaps two major advantages of using the automated data base system for floodplain management:

1. Organizational Structure

By using a computer's storage capabilities, vast amounts of detailed data such as flood prone areas for large geographical areas (eg. statewide) can be stored for instant retrieval, eliminating the problem for program managers of manually storing and shuffling boxes of maps.

2. Real-time Operational Use

The instant access capability of the geographic data base allows a user such as a developer, private home owner, local, state, or federal agency to cut red tape by getting a quick determination on whether a particular land parcel is in a flood prone area, and if any federal or state regulations (eg. flood insurance criteria) may apply. With the advent of new generation micro-computer technology, this can now be done in a very cost effective manner at a local or regional level.

The future use of a geographic data base technique for flood plain management should therefore provide both short term benefits for data storage and efficiency, and long term benefits for on-going and rapid access by decision makers to large volumes of data on a site specific basis.

TECHNICAL APPENDIX

DATA VARIABLE LIST

Technical Appendix #1

A-1

ELEMENT #	DATA CATEGORY	DATA ELEMENT

1. LAND USE - TRANSPORTATION : ROADS
   0 = none
   1 = limited access highway
   2 = divided highway/access
   3 = heavy duty road
   4 = medium duty road
   5 = light duty road
   6 = unimproved dirt
   7 = interchange (interstate)
   8 = overpass
   9 = railroad

2. LAND USE - AGRICULTURAL STRUCTURES
   0 = none
   1 = barns
   2 = poultry houses
   3 = other outbuildings

3. LAND USE - S. F. RESIDENTIAL
   0 = none
   1 = 10 acre lots
   2 = 5-10 acre lots
   3 = 2-5 acre lots
   4 = 1-2 acre lots
   5 = 1/2 - 1 acre lots
   6 = 1/2 acre lots

4. LAND USE - M. F. RESIDENTIAL
   0 = none
   1 = 5 units/acre
   2 = 5-10 units/acre
   3.= 10-15 units/acre
   4 = 15-20 units/acre
   5 = >20 units/acre

5. LAND USE - COMMERCIAL
   0 = none
   1 = regional shopping center
   2 = town center
   3 = community shopping center
   4 = stripand roadside

6. LAND USE - OFFICE AND INDUSTRIAL
   0 = none
   1 = office park
   2 = industrial park
   3 = light manufacturing
   4 = heavy manufacturing
   5 = extractive
   6 = petroleum storage
   7 = junkyards

7. LAND USE - PARKS AND RECREATION : OWNERSHIP
   0 = none
   1 = private
   2 = null
   3 = quasi-public
   4 = null
   5 = local
   6 = null
   7 = state
   8 = null
   9 = federal

8. LAND USE - INSTITUTIONAL
   0 = none
   1 = public administration
   2 = correctional
   3 = military
   4 = religious
   5 = health
   6 = cemeteries
   7 = educational
   8 = fire stations

9. LAND USE - AGRICULTURAL
   0 = none
   1 = cultivated areas
   2 = pasture
   3 = abandoned

10 VEGETATION - LAND COVER
   0 = 100% water
   1 = deciduous forest
   2 = coniferous forest
   3 = grassland
   4 = cultivated area
   5 = bare ground
   6 = rock outcrops, quarries
   7 = low density urban
   8 = high density urban
   9 = mixed forest

11. WATER QUALITY MANAGEMENT UNIT - BOUNDARIES
   0 - none
   1 = 1207
   2 = 1208
   3 = 1209
   4 = 1210
   5 = 1419

12. SURFACE WATER TYPE
   0 = none
   1 = streams
   2 = rivers
   3 = ponds
   4 = lakes
   5 = resevoirs

13. SURFACE WATER - WETLANDS
0 = none
1 = marsh (swamp)
2 = floodplain, estimated
3 = floodplain, verified

14. TOPOGRAPHIC SLOPE
0 = 100% water
1 = 0-3%
2 = 3-8%
3 = 8-15%
4 = 15-30%
5 = > 30%

15. UTILITIES AND SERVICES
0 = none
1 = power lines
2 = sewer lines
3 = gas lines
4 = water lines
5 = sewage treatment facility
6 = water treatment facility
7 = water storage facility
8 = landfill
9 = sanitary landfill

16. GEOLOGY
0 = unclassified
1 = aluminous schist
2 = amphibolite
3 = gneiss-schist-amphibolite
4 = quartzite, muscovite
5 = quartzite, feldspathic
6 = quartzite, mylonite
7 = alluvium
8 = quartz biotite-gneiss
9 = 100% water

17. ELEVATION
(not yet defined)

18. NATURAL AREAS
(not yet defined)

19. HISTORICAL AND ARCHAEOLOGICAL SITES
(not yet defined)

20. SOILS OF CONCERN
0 = none
1 = alluvium
2 = high shrink-swell
3 = exposed rock
4 = quarry
5 = escarpment

21. SOIL TYPE - SCS MAPPING UNITS
0 = 100% water
1 - 96 = soil type

22. PERMEABILITY - LAYER 1
0 = water and unclassified
1 = 0.06 - 0.60
2 = 0.20 - 0.60
3 = 0.06 - 2.0
4 = 0.60 - 2.0
5 = 0.60 - 6.0
6 = 1.0 - 2.0
7 = 2.0 - 6.0
8 = 2.0 - 20.0
9 = 6.0 - 20.0
10 = > 6.3

23. PERMEABILITY - LAYER 2
(same as #22)

24. PERMEABILITY - LAYER 3
(same as # 22)

25. PERMEABILITY - LAYER 4

26. HYDROLOGIC GROUP - SCS
0 = water or unclassified
1 = group A
2 = group B
3 = group C
4 = group D

27. Ph - AVERAGE SOIL REACTION
0 = water or unclassified
1 = < 4.5
2 = 4.4 - 5.0
3 = 5.1 - 5.5
4 = 5.6 - 6.0
5 = 6.1 - 6.5
6 = 6.6 - 7.3
7 = 7.4 - 7.8
8 = 7.9 - 8.4
9 = 8.5 - 9.0
10 = >9.1

28. K FACTOR - SURFACE
0 = water or unclassified
1 = 0.10
2 = 0.15
3 = 0.17
4 = 0.20
5 = 0.24
6 = 0.28
7 = 0.32
8 = 0.37
9 = 0.43

29. T FACTOR
0 = water
1 = 1
2 = 2
3 = 3
4 = 4
5 = 5
6 = 6
7 = 7

30 DEPTH TO WATER TABLE
0 = surface water
1 = 0.0 - 1.0'
2 = 0.0 - 2.5'
3 = 2.5 - 4.0'
4 = 2.5 - 5.0'
5 = 5.0 - 6.5'
6 = > 5.0'
7 = > 6.0'
8 = > 10.0'

31. DEPTH TO BEDROCK
0 = surface water or unclassified
1 = surface bedrock
2 = 0.0 - 1.5'
3 = 1.5 - 3.5'
4 = 3.5 - 6.5'
5 = 3.0 - 10.0'
6 = > 4.0'
7 = > 5.0'
8 = > 10.0'

32. PRIME AGRICULTURAL LAND - SCS
0 = water or unclassified
1 = additional farmland of local importance
2 = null
3 = additional farmland of state importance
4 = null
5 = unique farmland
6 = null
7 = prime farmland

33. COUNTY - BOUNDARY
0 = unclassified
1 = cobb county
2 = dekalb county
3 = fulton county
4 = gwinnett county

SOIL MAPPING UNITS

Technical Appendix #2

A-6

SOIL MAPPING UNITS

0 Unclassified

1 Altavista Fine Sandy Loam

2 Altavista Sandy Loam

3 Altavista Silt Loam

4 Appling Sandy Clay Loam

5 Appling Sandy Loam

6 Augusta Fine Sandy Loam

7 Ashlar Sandy Loam

8 Buncombe Loamy Fine Sand

9 Cartecay Soils

10 Cartecay Silt Loam

11 Cecil Clay Loam

12 Cecil Sandy Loam

13 Cecil Sandy Clay Loam

14 Chestatee Stony Sandy Loam

15 Chewacla Fine Sandy Loam

16 Chewacla Silt Loam

17 Congaree Fine Sandy Loam

18 Congaree Silt Loam

19 Congaree Loam

20 Davidson Clay Loam

21 Davidson Loam

22 Durham Sandy Loam

A-7

23 Grover Fine Sandy Loam

24 Gwinnett Sandy Loam

25 Gwinnett Sandy Clay Loam

26 Gwinnett Clay Loam

27 Gwinnett Loam

28 Gullied Land

29 Helena Sandy Loam

30 Hiawassee Sandy Loam

31 Hiawassee Clay Loam

32 Hiawassee Loam

33 Iredell Stony Clay Loam

34 Iredell Fine Sandy Loam

35 Lloyd Clay Loam

36 Lloyd Gravelly Sandy Loam

37 Lloyd Sandy Loam

38 Lockhart Clay Loam

39 Lockhart Sandy Loam

40 Louisa Fine Sandy Loam

41 Louisa Gravelly Sandy Loam

42 Louisa Soils

43 Louisburg Sandy Loam

44 Louisburg Stony Loamy Sand

45 Louisburg Loamy Sand

46 Made Land

47 Madison Clay Loam

48 Madison Fine Sandy Loam

A-8

49 Madison Gravelly Sandy Loam

50 Madison Sandy Loam

51 Madison Sandy Clay Loam

52 Mecklenberg Gravelly Sandy Loam

53 Mecklinberg Gravelly Clay Loam

54 Mixed Alluvium Poorly Drained

55 Mixed Alluvium Somewhat Poorly Drained

56 Mixed Alluvium Well Drained

57 Molena Loamy Sand

58 Musella Clay Loam

59 Musella Cobbly Loam

60 Musella Gravelly Soils

61 Musella Stony Sandy Clay Loam

62 Pacolet Sandy Clay Loam

63 Pacolet Sandy Loam

64 Pacolet Cobbly Sandy Loam

65 Red Bay Sandy Loam

66 River Wash

67 Roanoke Silt Loam

68 Rock Land

69 Seneca Fine Sandy Loam

70 Starr Loam

71 Stony Land

72 Toccoa Sandy Loam

73 Wedocee Sandy Loam

74 Wehadkee Fine Sandy Loam

A-9

75 Wehadkee Silt Loam

76 Wickham Fine Sandy Loam

77 Wickham Sandy Loam

78 Wilkes Stony Sandy Loam

79 Wilkes Sandy Loam

80 Worsham Sandy Loam

81 Hiawassee - Louisa Soils

82 Lockhart - Cecil Clay Loam

83 Lockhart - Cecil Sandy Loam

84 Madison - Grover - Louisa Gravelly Sandy Loam

85 Madison and Pacolet Soils

86 Musella and Pacolet Stony Soils

87 Urban Land - Appling Complex

88 Urban Land - Cecil Complex

89 Urban Land - Gwinnett Complex

90 Urban Land - Madison Complex

91 Urban Land and Pacolet Soils

92 Wilkes - Iredell Cobbly Complex

93 Cirban Land

94 Ashlar - Wedowee Complex

95 Congaree - Local Alluvium or Toccoa Sandy Loam

96 Chewacla Soils, Wet Variant

CODING STATISTICS

Technical Appendix #3

NORTH FULTON COUNTY DEMONSTRATION PROJECT

CODING STATISTICS

	TIME (HOURS)		
VARIABLES	TOTAL	PERCENT	AVE./FULL QUAD
1. Land Use- Transportation: roads	8.6	3.4	2.8
2. Land Use - Agricultural Structures	10.6	4.2	3.4
3. Land Use - S. F. Residential	19.1	7.5	6.1
4. Land Use - M. F. Residential	3.6	1.4	1.2
5. Land Use - Commercial	11.1	4.4	3.6
6. Land Use - Office & Industrial	6.1	2.4	2.0
7. Land Use - Recreational	5.1	2.0	1.6
8. Land Use - Institutional	5.9	2.3	1.9
9. 'and Use - Agricultural	13.9	5.4	4.4
10. Vegetation - Land Cover	60.4	23.7	19.3
11. WQMU - Boundaries	3.5	1.4	1.1
12. Surface Water Type	7.0	2.7	2.2
13. Surface Water - Wetlands	3.8	1.5	1.2
14. Topographic Slope	7.4	2.9	2.4
15. Utilities & Services	10.6	4.2	3.4
16. Geology	7.8	3.1	2.5
17. Centroid Elevation	22.6	8.9	7.2
18. Natural Areas	3.3	1.3	1.1
19. Historical & Archaeological Sites	(Data Not Available)		
20. Soils of Concern	6.8	2.7	2.2
21. Soil Types	33.8	13.2	10.8
22 ;2, 34-35. Soil Assoc. Tables	(Computer Generated)		
33. County Boundaries	4.1	1.6	1.3
TOTAL TIME	255.1	100%	81.6

A-11

NORTH FULTON COUNTY DEMONSTRATION PROJECT

CODING STATISTICS

DATA ELEMENT	TIME(PERCENT) TO ENCODE	DATA SOURCE
1. Land Use - Transportation:roads	3.3	USGS Quads, Color Aerials
2. Land Use - Agricultural Structures	4.1	USGS Quads, Color Aerials
3. Land Use - S.F. Residential	7.4	USGS Quads, Color Aerials
4. Land Use - M.F. Residential	1.4	USGS Quads, Color Aerials
5. Land Use - Commercial	4.3	USGS Quads, Color Aerials
6. Land Use - Office & Industrial	2.4	USGS Quads, Field Verification, Color Aerials
7. Land Use - Recreational	2.0	SCORP, ARC, Fulton County Planning
8. Land Use - Institutional	2.3	USGS Quads, Fire Stations
9. Land Use - Agricultural	5.4	USGS Quads, Color Aerials
10. Vegetation - Land Cover	23.3	USGS Quads, Color Aerials
11. WQMU - Boundaries	1.4	EPD-DNR, ARC, USGS Quads
12. Surface Water Type	2.7	USGS Quads, Color Aerials
13. Surface Water - Wetlands	1.5	Corps of Engineers, USGS Quads
14. Topographic Slope	2.9	USGS Quads, Fulton Co. Planning
15. Utilities & Services	4.1	USGS Quads, Color Aerials, Public Works
16. Geology	3.0	Geological & Water Resources Div/DNR
17. Centroid Elevation	8.7	USGS Quads
18. Natural Areas	1.3	Natural Areas Unit - OPR/DNR
19. Historical & Archaeological Sites	1.5	Historical Preservation - OPR/DNR
20. Soils of Concern	2.6	Soil Conservation Service
21. Soil Types	13.0	Soil Conservation Service
22-32, 34 Soil Assoc. Tables	---	Soil Conservation Service
33. County Boundaries	1.6	USGS Quads
35. Urban Intensity	---	Selected Data Elements
Time	100.0	

STUDY AREA SLIDES